

24. Zoological Results of the Third Tanganyika Expedition, conducted by Dr. W. A. Cunnington, 1904-1905. Report on some larval and young stages of Prawns from Lake Tanganyika. By Prof. G. O. Sars, C.M.Z.S.

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(Plates LVII.-LX.*)

INTRODUCTION.

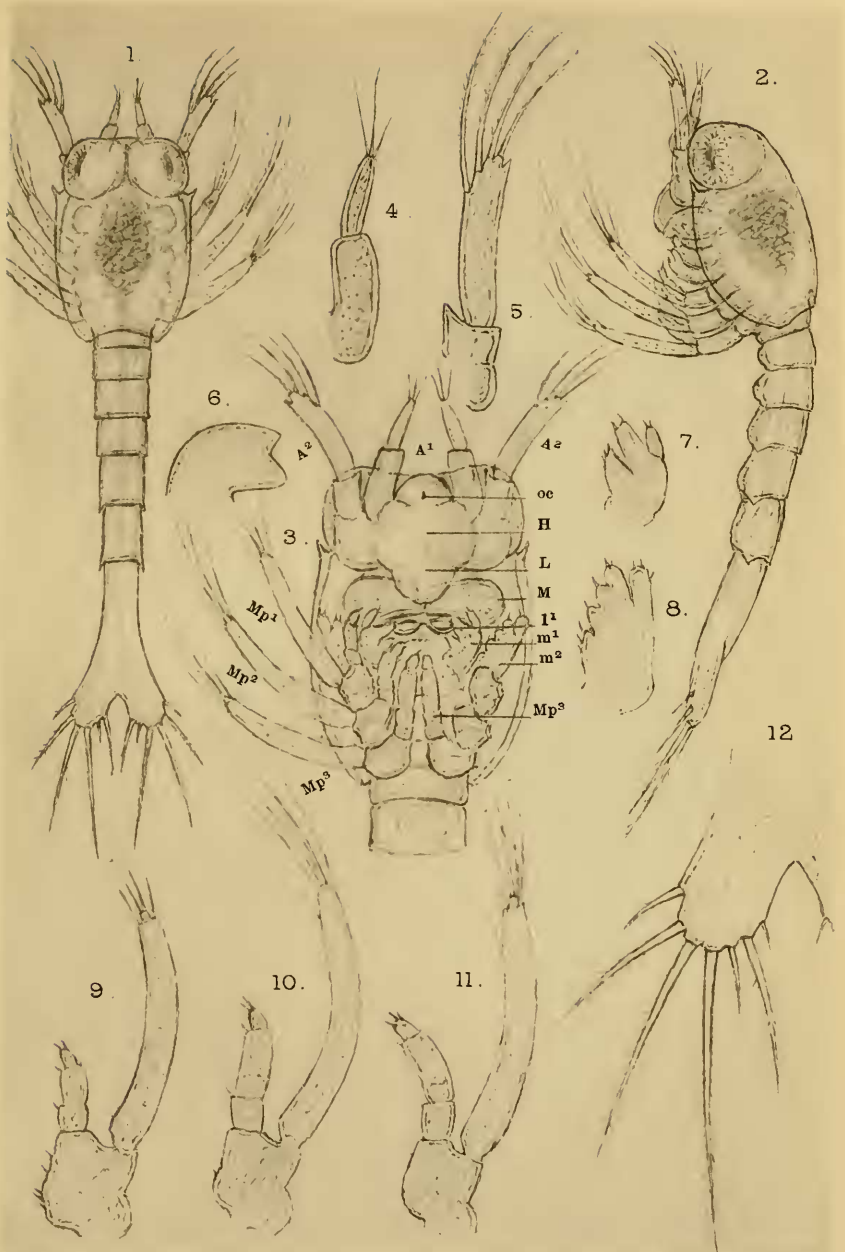
In the tow-nettings taken by Dr. Cunnington during the Third Tanganyika Expedition and placed in my hands for examination of the Copepoda and Ostracoda, some larval and young stages of Prawns were also found. Having submitted these stages to a closer examination, I find that some notes about them may be of interest. We owe to Prof. E. von Daday a rather elaborate account of the postembryonal development of *Caridina nilotica*, var. *gracilipes* (= *C. wyckii* de Man) from Lake Victoria Nyanza, and I have also myself had occasion to examine some larvæ from that lake, occurring in the samples taken by Dr. Cunnington. They agreed on the whole very well with the descriptions and figures given by Prof. Daday. On the other hand, the larvæ found in the samples from Lake Tanganyika have proved to be rather different, apparently owing to the fact that they belong to genera quite different from *Caridina*.

In the present paper I propose to describe three larval forms and one young one, representing as many different stages of development. Two of these forms undoubtedly represent very early larval stages (so-called Zoëæ); but they differ conspicuously both in size and in the development of the appendages, and apparently belong to two quite different kinds of prawns. Of course it is very difficult to decide with any claim of certainty as to the species or even genera to which these larvæ are referable; but I believe that they are in themselves interesting enough to merit a detailed description. They are here simply recorded as Zoëa Nos. 1 and 2, though some suggestions about their probable origin will be set forth. The 3rd form is a larva in the last, so-called *Mysis* stage; and the 4th is a very young prawn in the 1st postlarval stage. Both these forms admit of being more certainly referred to a definite species. At the close of this paper some general remarks will be given.

ZOËA No. 1. (Pl. LVII.)

This larva undoubtedly represents the very first postembryonal stage of some Tanganyika Prawn, having apparently just been hatched. It is remarkable for its small size and the very simple structure of the appendages, being indeed the most primitive

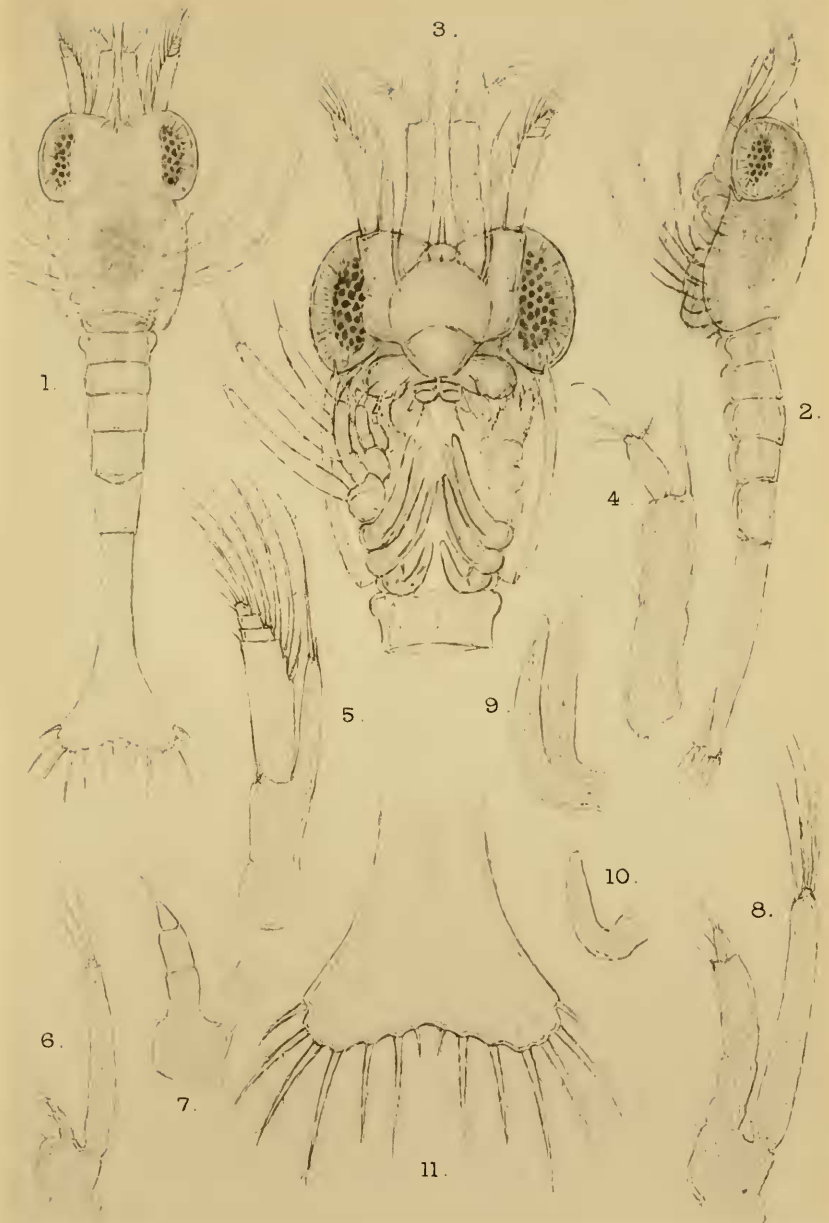
* For explanation of the Plates see pp. 439-440.



G. O. Sars.

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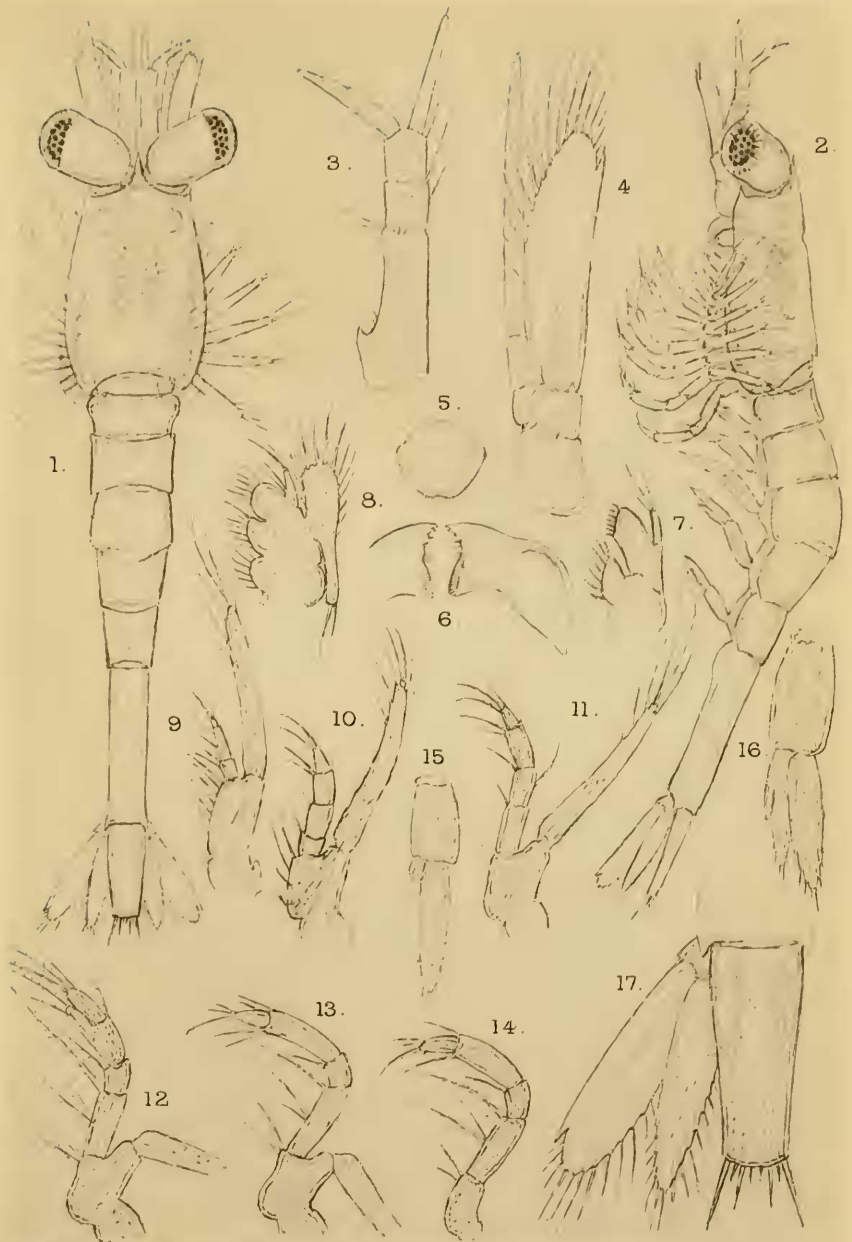
PRAWNS FROM LAKE TANGANYIKA.



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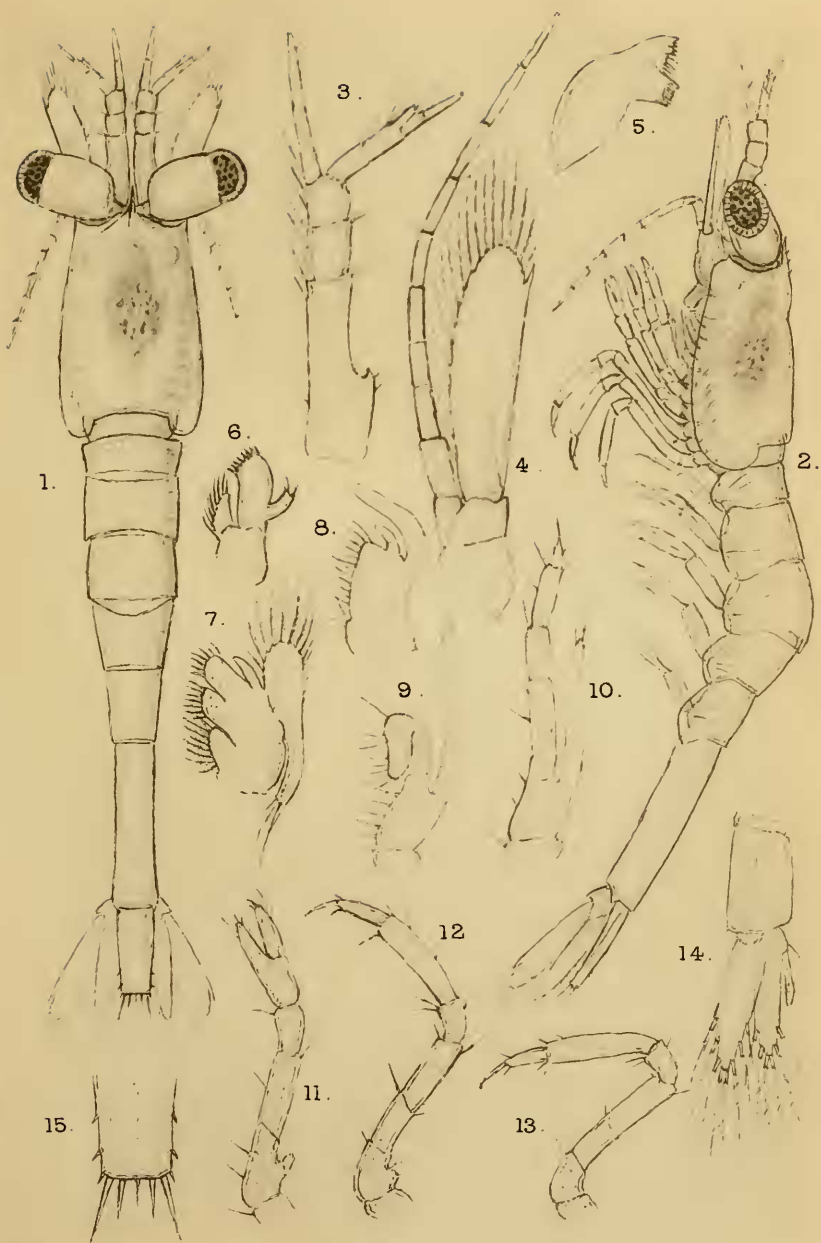
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PRAWNS FROM LAKE TANGANYIKA.

Caridean larva that I have ever met with, and in so far is very different from the earliest stage of *Caridina nilotica* described by Prof. Daday under the name of *Euzoëa*.

The *length* of the specimen examined, measured from the anterior edge of the eyes to the end of the caudal plate, is only 0.70 mm., and the present larva is accordingly not even half as large as the earliest stage of *Caridina nilotica*, the length of which, according to Prof. Daday, is 1.70 mm. If we imagine the larva curled up in its original embryonic attitude, we may approximately determine the length of the ovum from which it has escaped to have been 0.25 mm. by a width of 0.15 mm. This agrees pretty well with the measurements of the ova in *Limnocaridina spinipes* given by Dr. Calman, and as the form of the antennal scale in the present larva agrees better with that in this species than with that in any other of the Tanganyika prawns, I am led to the suggestion that it perhaps might be referable to *L. spinipes*, of which indeed an adult specimen was found in one of the four samples in which the present larvae occurred.

The *general form* of the body (Pl. LVII. figs. 1 & 2) is moderately slender, with the anterior division somewhat tumid and rounded oval in shape.

The *carapace* is evenly convex above and slightly emarginate behind in the middle, leaving the dorsal part of the hindmost segment of the trunk uncovered. At the antero-lateral corners a well-defined spine is present pointing obliquely outwards (see fig. 1). The anterior part of the carapace is badly defined, and no true rostrum could be detected, though a narrow stripe is seen extending forwards in the middle, without, however, forming any projection in front of the *eyes*. The latter are rather imperfectly developed, as compared with these organs in most other Caridean larvæ. They are apparently quite immobile, being contiguous at the base inside, and do not project beyond the lateral faces of the carapace. The corneal part is only faintly defined and contains a comparatively small and irregular mass of pigment, from which the visual elements radiate in the form of slight stripes, no corneal facets being as yet visible.

Immediately beneath the front parts of the eyes a semilunar lobe occurs (fig. 3, *oc.*), and within this lobe the *simple eye* (ocellus) may be faintly traced, for which reason it is here termed the ocellar lobe.

Of *appendages* only the two pairs of antennæ and the oral parts are as yet present, and all these appendages exhibit a very simple structure, being filled up with indifferent cells. Especially are the mandibles and maxillæ remarkable for their imperfect development, and indeed these parts seem to be quite unfit for any true mastication, the larva in all probability subsisting in this stage exclusively on the nutritive yolk, of which a considerable quantity is seen accumulated within the anterior part of the body.

The relative position of the appendages is best seen on viewing

the animal from the ventral face (fig. 3). The two pairs of antennæ (a^1 & a^2) originate on each side of a median slightly convex area, the hypostome (H), the one pair, the antennulæ (a^1), occurring in front and inside the other pair, the antennæ (a^2). From the hind part of the hypostome the flap-shaped anterior lip (L) is seen to arise covering the inner parts of the mandibles. The latter (M) are easily observed as two comparatively large, transverse, bow-shaped eminences, and immediately behind them in the middle the two rounded lobules of the posterior lip (l) are clearly seen. Behind these parts the two pairs of maxillæ have their place, the 1st pair, or anterior maxillæ (m^1), lying inside and slightly in front of the 2nd (m^2), which are extended obliquely outwards. The maxillæ are followed by three pairs of much larger appendages (mp^1 - mp^3) exhibiting a very similar appearance, each consisting of a short basal part and two diverging unequal rami, the inner one (endopodite) forming a short incurved stem, the outer one (exopodite) a much larger, laterally extended natatory ramus. These three pairs of appendages, which are separated in the middle by a somewhat irregular flattened area (the sternal plastron), represent the maxillipeds in the adult animal. Behind them not even the slightest trace of any pedal buds is to be detected.

The posterior division of the body, or *metasome* (figs. 1 & 2), is rather slender, being about twice as long as the anterior division, and is composed of six well-defined segments, the last of which is much the longest and very narrow. This segment passes without any intervening suture into the caudal plate. The latter is rather unlike that found in most other Caridean larvæ and more resembles in shape that part in the protozoëa stage of *Penæus*. As in that form, it is cleft by a deep median incision into two slightly diverging lobes obtusely rounded at the end. Each lobe carries six finely ciliated setæ of rather unequal length, the outermost one and the innermost but one being considerably smaller than the others. The 4th seta, counted from the outer side, is the longest, equalling in length the last segment to the bottom of the median incision. In some of the larvæ, which otherwise agreed with that here figured, a very small additional seta occurred inside the others on each lobe (fig. 12). On the anterior caudal segments slight traces of the epimeral plates could be detected, those of the 4th and 5th segments terminating in an acute corner. The ventral faces of the segments are somewhat convex; but not the slightest trace of pleopoda is as yet observable.

Structure of the Appendages.

The *antennulæ* (fig. 4) are comparatively small, and each consists of a simple biarticulate stem extended forwards. The proximal joint is much the larger and represents the peduncle. It is, however, quite simple, without any trace of a subdivision and exhibits no armature whatever. The distal joint is much narrower than the proximal one, and also shorter, of oblong-oval

form, and movably articulated to the former. It carries on the tip three or four very delicate bristles, one of which seems to be sensory in character. This joint undoubtedly answers to the outer flagellum in the adult animal. Of the inner flagellum not the slightest trace is to be found in the present larva, whereas in all other larvæ known to me it is at least indicated by a strong seta attached to the inner distal corner of the peduncle.

The *antennæ* (fig. 5), like the antennulæ, are each composed of two sharply defined joints, the proximal of which forms a thickish basal part imperfectly subdivided in the middle, and produced at the end inside to a short conical prominence indicating the place where subsequently the flagellum will be developed. The distal joint, representing the antennal scale, is considerably longer than the basal part and of narrow linear form. Its outer edge is perfectly smooth and terminates in a well-marked tooth-like projection, whereas the inner edge carries in its outermost part four strong ciliated setæ attached to as many well-marked ledges and curved somewhat outwards. In most other Caridea known to me the antennal scale exhibits in the earlier stages of the larval period a rather different structure, its distal part being narrowly produced and divided by well-marked transverse sutures into several successive joints. Of such a subdivision not the slightest trace is found in the present larva, nor is the distal part of the scale produced beyond the tooth of the outer corner, this tooth in other Caridean larvæ being formed only at a much later period.

The *mandibles* (fig. 6) have the inner, or masticatory, part somewhat expanded and divided by a slight median incision into two lobes; but neither of these lobes exhibits the slightest trace of any armature.

The *anterior maxille* (fig. 7) are trilobate, with the outermost lobe (palp) well defined as a distinct joint. The middle, or masticatory, lobe is somewhat more prominent than the innermost, or basal lobe. All three lobes extend obliquely inwards and have only very slight traces of marginal spines or setæ.

The *posterior maxille* (fig. 8) have the form of oblong oval plates, the edges of which are irregularly indented or divided into a number of rounded lobules. The two outermost of these lobules are separated by a somewhat deeper incision, and represent the one the exopodal, the other the endopodal part, the remaining three lobules of the inner edge representing the true masticatory lobes in the adult animal. As in the anterior maxilla, only very slight rudiments of setæ are present on the lobules.

The three pairs of *maxillipeds* (figs. 9, 10, & 11), as above stated, are of a very similar structure and only differ in the relative size of the endopodite. The basal part consists of two imperfectly defined segments and is a little broader and more flattened in the 1st pair (fig. 9) than in the other two. The endopodite forms a slightly incurved cylindric stem and gradually increases in length from the 1st to the 3rd pair. In the 1st pair it is

scarcely longer than the basal part and divided only into three joints. In the other two pairs (figs. 10, 11) the middle joint appears faintly subdivided behind the middle. Very small setæ in process of formation are seen on the terminal joint, and partly also on some of the other joints inside. The exopodite, which is movably attached to the outer distal corner of the basal part, is in all three pairs of exactly the same appearance, forming a very flexible, somewhat flattened stem with four long ciliated setæ at the end, two of them issuing from a minute apical joint. In the two posterior pairs another rather small seta is seen issuing inside at some distance from the end.

Occurrence.—Several specimens of this peculiar larva, all closely agreeing both in size and structure, were obtained from four different samples. Two of these samples were taken at Niamkolo (S. end of lake), another at Mbete (likewise at the south end of the lake), and the fourth at Sumbu (S.W. of lake).

ZOËA No. 2. (Pl. LVIII.)

The differences between this and the preceding larva are so conspicuous, that I think we are justified in assuming that it belongs to a different kind of prawn. It is of much larger size, and in some respects exhibits considerably more advanced development. Yet the imperfect structure of the oral parts, in connection with some other features, would seem to prove that it in reality represents a very early larval stage.

The *length* of the specimen examined is about 1.60 mm., and the size of this larva is accordingly more than twice that of the preceding one, and nearly equals that indicated by Prof. Dađay for the earliest observed stage (EuZOËA) of *Caridina nilotica*. The present larva cannot, however, by any means belong to that species, which does not occur in Lake Tanganyika, but must be derived from some other form of prawn, in which the ova are of a similar size to those in the said species. Consulting again the paper of Dr. Calman, we find that in this respect only one of the Tanganyika prawns would seem to come under consideration, viz., *Caridella cunningtoni* Calman, the ova of which are in reality much larger than in any of the other forms examined. I am therefore led to the conclusion that the present larva in all probability may be an early stage of that form.

As compared with the preceding larva, the *body* (Pl. LVIII. figs. 1 & 2) appears rather short and stout, with the anterior division considerably dilated and the posterior one less slender.

The *carapace* is somewhat gibbously vaulted in its anterior part, and, as in the preceding larva, is slightly emarginated behind in the middle. At the antero-lateral corners a well-marked spine occurs; but this spine does not project laterally (fig. 1). Anteriorly the carapace is produced into a well defined, though quite simple narrow spiniform rostrum, which projects distinctly in front.

The *eyes* are of very large size and somewhat project beyond the lateral faces of the carapace (fig. 1). They are, however, like those in the preceding larva, still imperfectly separated in the middle and apparently quite immobile. The corneal part is well defined and contains a semi-oval assemblage of a dark pigment, from which numerous distinctly developed visual elements radiate. The ocellar lobe is partly visible in the dorsal aspect of the animal immediately in front of the eye-bases, but appears more distinctly on viewing the animal from the ventral face.

As to the *appendages*, fig. 3 will give a general view of their form and arrangement in the present larva. On comparing this figure with fig. 3 on Pl. LVII., it is at once seen that both the antennule and the antennæ are considerably larger and also more advanced in development. On the other hand, the oral parts (anterior and posterior lips, mandibles and maxillæ) are very little different. The same is also the case with the three pairs of maxillipeds; but these appendages appear in the present larva more densely crowded and more remote from the hind limit of the mesosome, a considerable space being left behind them, which is occupied by three additional pairs of limbs not found in the preceding larva. These limbs, representing the three anterior pairs of legs are, however, still only in process of formation, being quite immobile and folded beneath the mesosome.

The *metasome* (figs. 1 & 2) is not fully twice as long as the anterior division of the body, and, as in the preceding larva, consists of six segments, the last of which is very narrow in its anterior part, but gradually expands distally, to form the caudal plate. The latter is comparatively smaller than in most other Caridean larvæ, and looks rather different from that in the preceding larva, not being cleft into two lobes, but only slightly emarginated behind in the middle (see also fig. 11). Each half of the plate carries the usual number of marginal setæ, viz. 7, the outermost and innermost ones being rather small, the others nearly equal-sized and comparatively shorter than in the preceding larva. Of uropoda or pleopoda no traces are to be found.

Structure of the Appendages.

The *antennule* (fig. 4) have the peduncle rather prolonged and of cylindrical form, with a slight indication of subdivision into three joints. The outer flagellum, as in the preceding larva, consists of a single oblong oval joint carrying on the lip four unequal bristles, the innermost one distinctly ciliated. The inner flagellum, as in most other Caridean Zoëæ, is replaced by a strong ciliated seta attached to the inner distal corner of the peduncle. This seta, however, scarcely exceeds half the length of the peduncle, whereas in the earliest stage of *Caridina nilotica* it is, according to Prof. Daday, nearly twice its length.

The *antennæ* (fig. 5) exhibit the three principal parts well defined. The basal part scarcely differs in structure from that in

the preceding larva; but at its distal inner corner, in place of the simple conical projection found in that larva, a well-defined cylindrical stem has been formed representing the flagellum. This stem is about the length of the basal part and exhibits a slight trace of subdivision behind the middle. It terminates in a spiniform process from the base of which a rather long ciliated seta originates. The antennal scale is rather unlike that in the preceding larva, and agrees more in structure with that generally found in Caridean Zoëæ. It exceeds the flagellum by about one quarter of its length and is of narrow oblong form, slightly curved outwards. Its distal part is narrowly produced and divided by well-marked transverse sutures into three successive joints gradually diminishing in size. The scale carries inside and at the tip a regular row of eight ciliated setæ and has, moreover, outside the tip a very small hair-like bristle. Another similar bristle is also seen originating from the outer distal corner of the proximal joint.

The *mandibles* and *maxillæ* do not seem to exhibit any essential difference in their structure from those in the preceding larva, and are scarcely as yet functionally developed.

The three pairs of *maxillipeds* (figs. 6-8) likewise exhibit much the same structure, though the difference in size of the endopodite is still more sharply marked than in the preceding larva, that of the 1st pair (fig. 6) being extremely small as compared with those of the two succeeding pairs, the size of which is also somewhat unlike.

Of the three pairs of imperfectly developed appendages succeeding the maxillipeds the two anterior ones (fig. 9), representing the developing *chelipeds*, are bifid or cleft into two nearly equal digitiform rami, one of which is the endopodite, the other the exopodite. The posterior pair (fig. 10) are still undivided and shorter than the two anterior ones. They represent the first pair of *pereiopoda*, the last two pairs being not yet formed. All these appendages exhibit a very simple structure and are filled up with indifferent cells, no articulation or setous armature being observable.

Occurrence.—Of this larva also several specimens, exactly agreeing with each other, were found. They occurred in two of the samples, the one taken at Niamkolo, the other at Mbete, both located at the south end of the lake.

LARVA No. 3. (Pl. LIX.)

This larva represents a much more advanced stage than the two preceding ones, and therefore can be determined with more certainty. I think that I am right in considering it as the last larval stage, the so-called Mysis-stage, of *Limnocaridina parvula* Calman. The solitary specimen which has come under my notice, was found in a sample which contained several young specimens of that prawn, and both as to size and general